Water Quality

Analysis of the water quality used in cooling systems provides information regarding potential corrosion and deposition problems. The primary parameters of concern are total hardness and calcium hardness, alkalinity, silica, and total suspended solids. In certain cases, ammonia, phosphate, iron, total dissolved solids, organics, heavy metals, and microorganisms may also be of concern.

Consistent water quality, such as that of Title 22 water, limits the amount of water monitoring, treatment, and control that is necessary to maintain system operations.

Factors to Consider Prior to Conversion:

- Refinery equipment
- Chemical treatment
- Water quality

Refinery Equipment and Chemical Treatment

Open recirculating cooling systems are the most common approach for cooling in refineries, making heat exchangers and cooling towers the critical equipment. These systems employ evaporative cooling. Dissolved minerals concentrate in the cooling water through the evaporative process and impact scaling, corrosion, and microbiological activity within the heat exchangers and cooling towers.

Chemical treatment of cooling water is designed to: ensure adequate, reliable, continuous, and efficient heat transfer in the system heat exchangers and cooling towers; and maintain and maximize the life expectancy of all equipment in contact with the water.

Chemical treatment of boiler makeup water is designed to: ensure maximum and reliable fuel to steam thermal efficiency; and maintain and maximize the life expectancy and efficiencies of the pre-boiler, and post-boiler systems as well as the boilers themselves.

Water Quality Parameters for Refinery Water Supplies

Constituent	Potable Water Annual Average mg/L	Title 22 Water Annual Average mg/L	Nitrified Title 22 Water Weekly Average mg/L	Single Pass RO Water Weekly Average mg/L
Total Dissolved Solids	700	689	800	25
pH	NA	7.2	7	7
Total Hardness	205	196	185	2
Total Alkalinity	160	280	64.7	20
Nitrate (NO3)	NA	4.8	134	1
Ammonia (NH3)	0	37.2	0	1.9
Total Phosphate (PO4)	0	6.3	5.9	0.5
Silica (SiO2)	25	23	21	0.36
Total Organic Carbon	NA	11	8.7	0
Total Suspended Solids	NA	1	5	0

For more information, please visit
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The Hot and Cold of Recycled Water in Refineries

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West Basin MWD

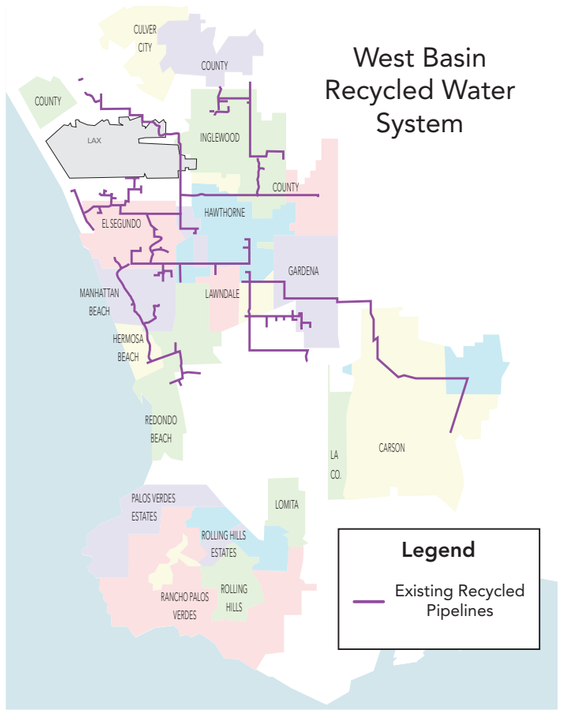
California Department of Water Resources

Central Basin MWD

Background

The West Basin Municipal Water District (MWD) water-recycling plant receives effluent from the City of Los Angeles's wastewater treatment plant, Hyperion. Further treatment, such as flocculation and filtration or microfiltration and reverse osmosis (RO) and disinfection with chlorine, is performed at the West Basin MWD plant. The resultant water quality is consistent with criteria established by the California Department of Health Services in Administrative Code Title 22, this water quality is referred to as "Title 22".

The crude oil refining industry in the Los Angeles area was historically and continues to be the largest user of freshwater, primarily for process cooling and boiler makeup.



West Basin Recycled Water System

Case History 1 – Southern California

- Began nitrified Title 22 water service for cooling towers in 1995, added RO permeate for boiler makeup water in 2001
- Average cooling tower supply is 6,500 acre-feet per year and boiler makeup supply is 3,400 acre-feet per year
- Cooling tower results:
  - Cycles of concentration remain the same, 4-6
  - Overall improvement in the cooling systems operation
- Boiler makeup results:
  - Cycles of concentration improve from 8-10 to 50
  - Near optimum equipment protection and maintenance

Case History 2 – Southern California

- Began Title 22 water service for cooling towers in 1999, mixture of 30% groundwater and a 70% blend of RO (85%) and nitrified Title 22 (15%)
- Average cooling tower supply is 3,000 acre-feet per year
- Cooling tower results:
  - Cycles of concentration have improved from 4-5 for potable water to 10-14
  - Cooling systems operations have greatly improved, approaching excellent improvement

Case History 3 – Southern California

- Began nitrified Title 22 water service for cooling towers in 1996, added RO permeate for boiler makeup water in 2000
- Average cooling tower supply is 3,250 acre-feet per year and boiler makeup supply is 1,700 acre-feet per year
- Cooling tower results:
  - Cycles of concentration remain the same, 4-6
  - Overall improvement in the cooling systems operation
- Boiler makeup results:
  - Cycles of concentration remain the same, 8-10
  - No change in equipment protection and maintenance

Benefits of Using Recycled Water

Lower operations and maintenance costs
- Lower requirements for salt, acid, and caustic soda
- Improved quality control
- Fewer and lower cost repairs
- Avoidance of premature system turnaround or equipment replacement

Reduced energy requirements
- Reduced pumping costs
- Higher thermal efficiencies

Water supply reliability